(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 154 673 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
14.11.2001 Bulletin 2001/46

(51) Int Cl.[7]: **H04R 25/00**

(21) Application number: **00610046.5**

(22) Date of filing: **12.05.2000**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(71) Applicant: **OTICON A/S**
2900 Hellerup (DK)

(72) Inventor: **Christensen, Thomas E.**
2900 Hellerup (DK)

(54) Combining two signals in a hearing aid

(57) The invention relates to a method for output signal generation in a communication device in which a primary signal is generated in a primary signal path and a secondary signal is generated in a secondary signal path, the method comprising: adding the primary signal to the secondary signal by adding a first magnetic field to a second magnetic field. The invention further relates to a device and a hearing aid for implementing the method according to the invention as well as an output transducer for use in a communication device.

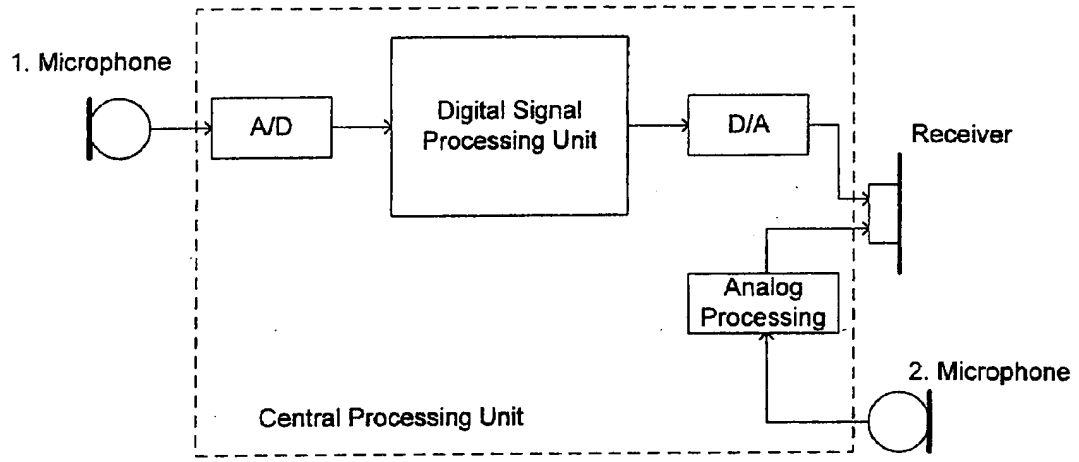

FIG. 1

EP 1 154 673 A1

Description

FIELD OF THE INVENTION

[0001] The invention relates to communication devices, more specifically to the problem of combining two electrical signals, e.g. in connection with the presence of an occlusion effect or acoustical feedback or noise cancellation in a hearing aid, a headset or a telephone.

BACKGROUND OF THE INVENTION

[0002] Communication devices of various kinds are known where two or more signals often could be combined in order to achieve a desired effect. The communication devices count hearing aids, headsets and telephones, especially mobile telephones.

[0003] Hearing aids are devices intended for providing remedy for a hearing impairment experienced by a person. The hearing aid typically comprises a microphone, an amplifier and an output receiver assembled in a housing to be placed behind the ear or in the ear of the user. Examples from the hearing aid area counts occlusion effect and acoustic and magnetic feedback, which can be very annoying and often will totally destroy the communication to and from the hearing aid user.

[0004] A headset typically comprises at least one output transducer and one input transducer, for output of e.g. a telephone signal and for input to a telephone, respectively. Connecting wires or a wireless connection to a telephone may be provided.

[0005] A mobile telephone typically comprises at least one output transducer and one input transducer and receiving and transmitting means.

[0006] It is apparently desirous in hearing aids and other communication devices, such as headsets and telephones to combine two or more signals in order to provide a compensation for an undesired signal influencing the use of the communication device. This is particularly relevant in noisy environments and when the communication device is used by a person who has a hearing impairment making speech understanding more difficult when an environmental distortion is present.

[0007] In the field of hearing aids the occlusion effect and feedback problems are well-known phenomenon, which gives rise to a significant irritation and discomfort when using a hearing aid.

[0008] From other areas, such as the headset and the telephone areas, the problems are most often noise related. Noise reduction algorithms are often implemented in order to achieve a more clear communication.

[0009] For all areas counts that the combination of signals sets significant demands to the signal processing equipment. The problems of combining two or more signals in fact often gives rise to several problems and the result of the combination often results in a significantly reduced quality of the desired signal. The problems of combining two signals are particularly significant when the one signal is a digital signal and the other signal is an analog signal. In this situation the negative influence of the signals on each other is often devastating.

[0010] An objective of the present invention is to provide a method by which two signals may be added to each other with reduced negative influence on the desired output signal.

[0011] Another objective of the present invention is to provide a communication device where two signals may be added to each other with reduced negative influence on the desired output signal.

[0012] A further objective of the present invention is to provide a hearing aid, where two signals may be added to each other with reduced negative influence on the desired output signal.

[0013] A still further objective of the present invention is to provide a receiver (speaker), which can be used in a hearing aid of the type mentioned above in connection with the adding of two signals to each other with reduced negative influence on the desired output signal.

SUMMARY OF THE INVENTION

[0014] According to the invention the first objective is achieved by means of a method as defined in claim 1.

[0015] Preferred embodiments of the method are disclosed in claims 2-4.

[0016] According to the invention the second objective is achieved by means of a device as defined in claim 5.

[0017] Preferred embodiments of the device are disclosed in claims 6-8.

[0018] According to the invention the third objective is achieved by means of a hearing aid as defined in claim 5.

[0019] Preferred embodiments are described in claims 10-13.

[0020] According to the invention the fourth objective is achieved by means of a speaker as defined in claim 14.

[0021] Preferred embodiments of the receiver are disclosed in claims 15.

[0022] The invention is explained in more detail with reference to the drawings in the following description of preferred embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] FIG. 1 is a schematical diagram showing the principles of the invention.

[0024] FIG. 2 is a schematical drawing of a hearing aid featuring the invention;

[0025] FIG. 3 is a schematical drawing showing a receiver according to the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0026] From FIG. 1 the principles of a hearing aid fea-

turing the invention appear. A first microphone is provided for picking up acoustic input from the environment. The acoustic signals are transformed into an analog electric signal and converted into a digital signal in an AD converter. Afterwards the digital signal is processed and amplified in a processor. Following the processing the processed signal is converted into an analog signal in a DA converter and supplied to an output transducer, a so-called receiver. A second microphone is provided for picking up a boneconducted signal or an acoustic feedback signal. The boneconducted signal may result in the previously described occlusion effect and the acoustic feedback signal may result in a closed feedback loop giving rise to an uncontrolled oscillation in the hearing aid. Both situations are undesired for the hearing aid user. The signal picked up by the second microphone is processed and afterwards supplied to the same output transducer as the first signal. The output transducer features two separate driving coils and the first and the second signal are supplied one to each of these coils.

[0027] From FIG. 2 a hearing aid appears showing the location of the respective elements described in connection with FIG. 1. The necessary power supply, preferably a battery, is not shown. The skilled person will however immediately be able to implement this.

[0028] From FIG. 3 an output transducer appears in a cross sectional view. It appears that two electrically separated driving coils are located within a transducer housing. The driving coils are located in such a manner that each of these upon receiving an electrical signal through the terminals provided on the outside of the transducer housing will induce a field that drives the membrane likewise provided in the transducer housing. By providing the two driving coils electrically separated in the transducer housing a compact unit may be achieved and the two individual signals may be supplied to the transducer without interfering with each other. The two signals are hence supplied to the transducer in their desired undisturbed form and the resulting acoustic output signal will show a superpositioning of the two signals. In this manner it is possible to add a digital and an analog signal to each other, without disturbing one or both of the signals, and achieve a desired combined signal. It is of course also possible to combine two digital or two analog signals and still achieve an improvement in the combined signal.

[0029] Although the invention in the foregoing description of a preferred embodiment has been explained as implemented in a hearing aid, the invention is applicable to other types of personal communication equipment, such as headsets and mobile telephones.

Claims

1. A method for output signal generation in a communication device in which a primary signal is generated in a primary signal path and a secondary signal is generated in a secondary signal path, the method comprising: adding the primary signal to the secondary signal by adding a first magnetic field to a second magnetic field.

2. A method according to claim 1, comprising generating the secondary signal as an analog signal.

3. A method according to claim 1 or 2, where the primary signal is a digital signal.

4. A method according to any of the claims 1-3, comprising picking up at least one acoustic or magnetic signal by the communication device.

5. A communication device comprising:

   - first signal processing means for processing the first electrical signals;
   - second signal generating means for generating a second electrical signal;
   - output means for outputting the processed electrical signals;
   - where means are provided for generating a first magnetic field and a second magnetic field in connection with the output means.

6. A device according to claim 5, where at least one microphone is provided for picking up at least one acoustic signal.

7. A device according to claim 5 or 6, where a further microphone is provided for picking up a further acoustic signal.

8. A device according to any of the claims 5-7, where a processor is provided for establishing one or more characteristics of an incoming signal.

9. A hearing aid comprising:

   - a first microphone adapted to pick up acoustical signals outside the ear of the hearing aid user and transform these into first electrical signals;
   - first signal processing means for processing the first electrical signals;
   - second signal generating means for generating a second electrical signal;
   - output means for outputting the processed electrical signals;
   - where means are provided for generating a first magnetic field and a second magnetic field.

10. A hearing aid according to claim 9, where the output means is a receiver comprising at least two driving coils; where one coil is adapted to generate a first magnetic field in correspondence with a first signal;

and where another coil is adapted to generate a second magnetic field in correspondence with a second signal.

11. A hearing aid according to claim 9 or 10, where the second signal path comprises means for processing an analog signal.

12. A hearing aid according to claim 9 or 10, where the first signal path comprises means for generating and processing a digital signal.

13. A hearing aid according to claim 9, where the second signal generating means comprises a second microphone and a second signal processor.

14. An output transducer for a communication device, the transducer comprising:

- a membrane, adapted to oscillate in correspondence to input signals;
- at least two electrically separated driving coils;
- where one coil is adapted to generate a first magnetic field in correspondence with a first input signal;
- and where another coil is adapted to generate a second magnetic field in correspondence with a second input signal.

15. A transducer according to claim 14, where the membrane and the two electrically separated coils are contained in a single housing.

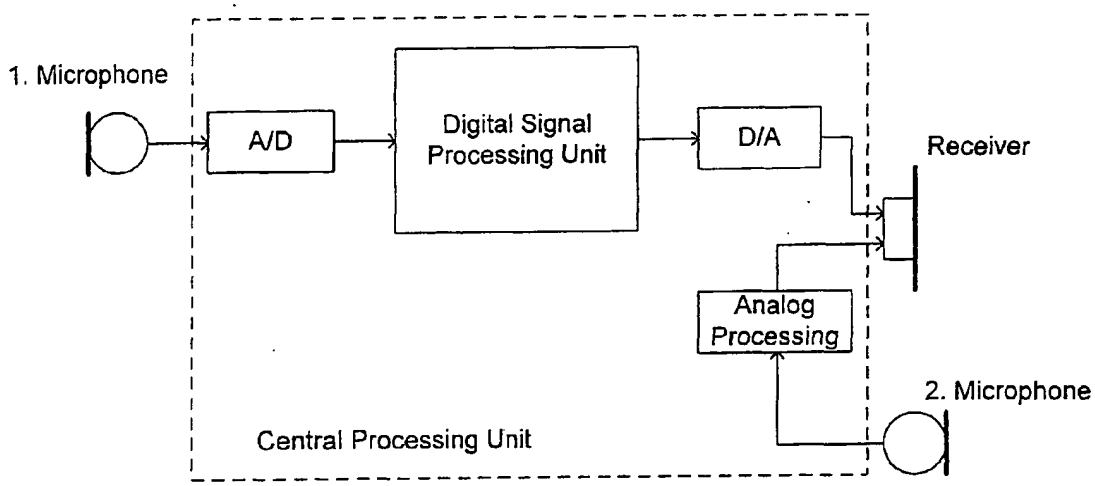
1. Microphone
A/D
Digital Signal Processing Unit
D/A
Receiver
Analog Processing
2. Microphone
Central Processing Unit

FIG. 1

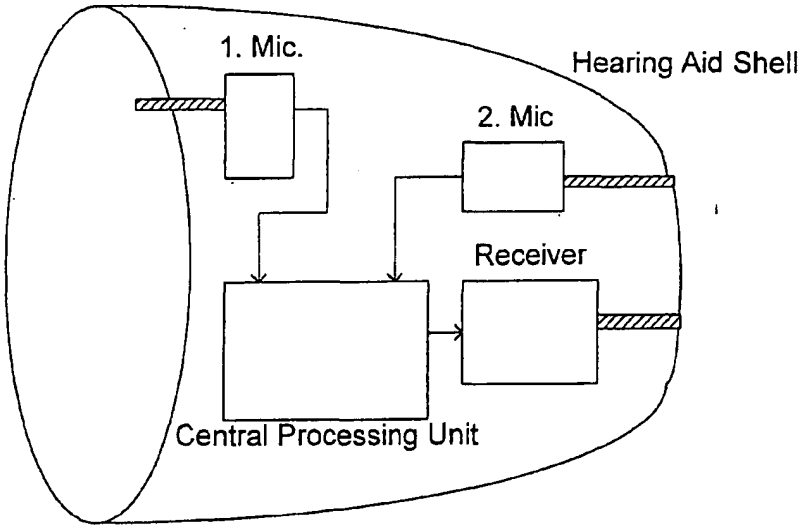
1. Mic.
Hearing Aid Shell
2. Mic
Receiver
Central Processing Unit

FIG. 2

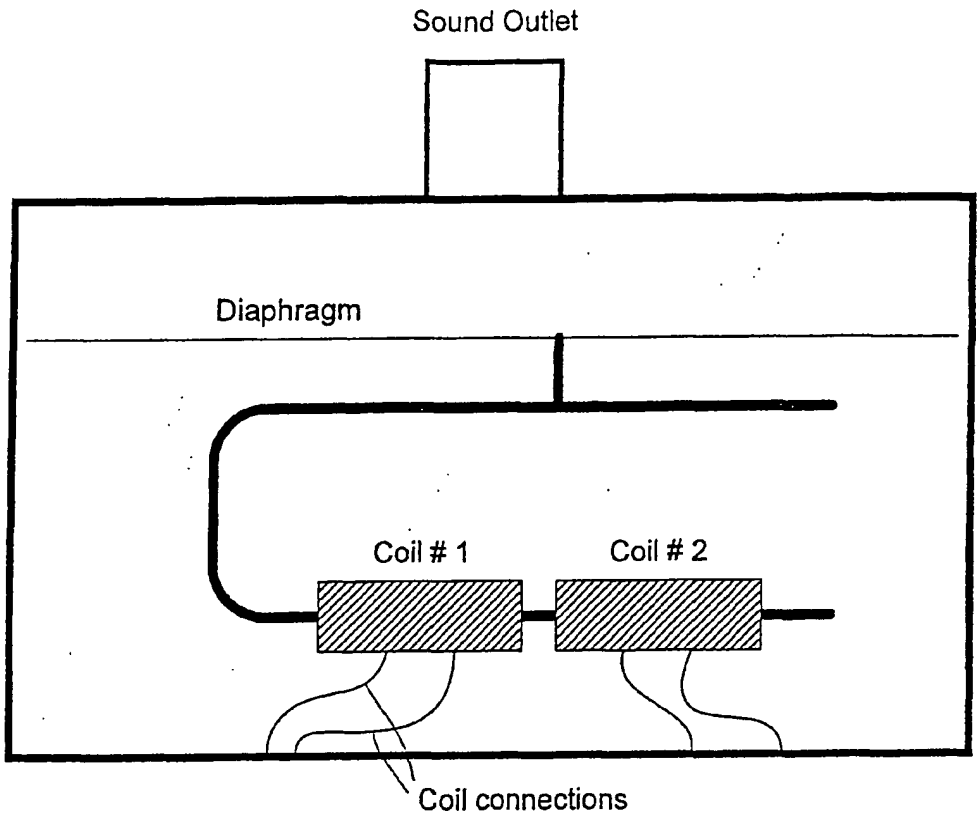

FIG. 3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 00 61 0046

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
Y	PATENT ABSTRACTS OF JAPAN vol. 018, no. 003 (E-1485), 6 January 1994 (1994-01-06) -& JP 05 244696 A (HITACHI LTD), 21 September 1993 (1993-09-21)	1,3-10, 12-15	H04R25/00
A	* abstract *	2,11	
Y	PATENT ABSTRACTS OF JAPAN vol. 018, no. 608 (E-1633), 18 November 1994 (1994-11-18) -& JP 06 233389 A (SONY CORP), 19 August 1994 (1994-08-19)	1,3-10, 12-15	
A	* abstract *	2,11	
Y	EP 0 137 550 A (PHILIPS NV) 17 April 1985 (1985-04-17) * page 1, line 18-21 * * figure 1 *	1,3-10, 12-15	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

H04R

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	30 March 2001	Zanti, P

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 00 61 0046

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

30-03-2001

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 05244696 A	21-09-1993	NONE	
JP 06233389 A	19-08-1994	NONE	
EP 0137550 A	17-04-1985	NL 8303186 A	01-04-1985
		CA 1219811 A	31-03-1987
		DE 3467846 D	07-01-1988
		JP 7020308 B	06-03-1995
		JP 60076898 A	01-05-1985
		US 4566120 A	21-01-1986

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82